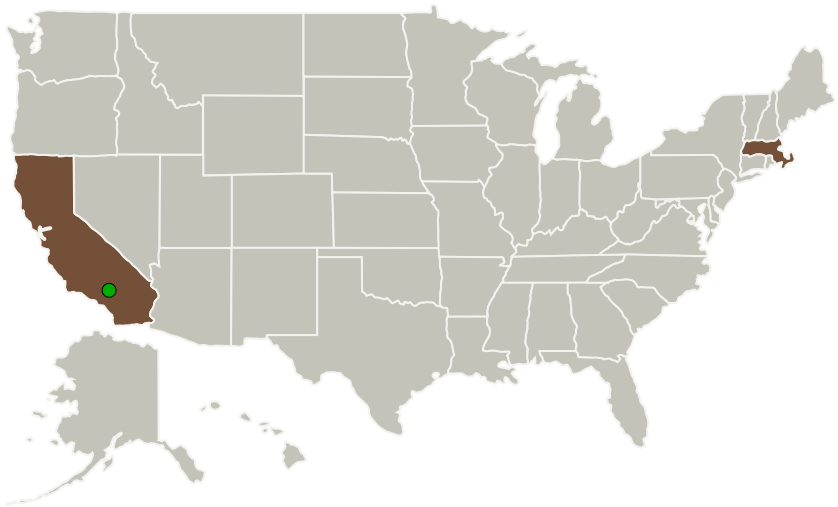
Magnesium Based Rockets for Martian Exploration, Phase II

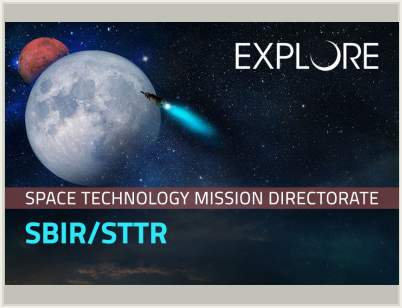
Completed Technology Project (2011 - 2013)

Project Introduction

In the proposed Phase II program, we will continue the development of Mg bipropellant rockets for Martian PAV applications. In Phase I, we proved the feasibility of this game-changing technology. Through chemical analysis, we determined that Mg can be combusted with CO2 condensed in-situ from the Martian atmosphere to yield Isp ~240 s. We then successfully demonstrated a low fidelity Mg-CO2 rocket in the laboratory, achieving combustion for 43s before voluntary termination. We also analyzed the use of H2O and H2O2 as oxidizers, and Al as a propellant. H2O exists at the Martian poles and below the surface, while both Mg and Al can be acquired in-situ from the Martian regolith. We determined that the ideal vacuum Isp of a 10 bar Mg-H20 rocket would be as high as ~340 s, while the Isp of a Al-steam rocket would be ~380 s, and hydrogen peroxide could yield higher density Isp and operational benefits. In Phase II we plan to develop and test an integrated high performance laboratory model system. We will first fully characterize multiple propellant oxidizer combinations in a linear combustor. Then we will design, build, and test an integrated system including both a rocket and a propellant management system. Comprehensive test results would feed back into the design, culminating in an advanced system sized for prospective near-term applications.

Primary U.S. Work Locations and Key Partners





Magnesium Based Rockets for Martian Exploration, Phase II

Table of Contents

Magnesium Based Rockets for Martian Exploration, Phase II

Completed Technology Project (2011 - 2013)

Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
Armstrong Flight Research Center(AFRC)	Supporting Organization	NASA Center	Edwards, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

June 2011: Project Start

November 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139072)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Busek Company, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

James Szabo

Co-Investigator:

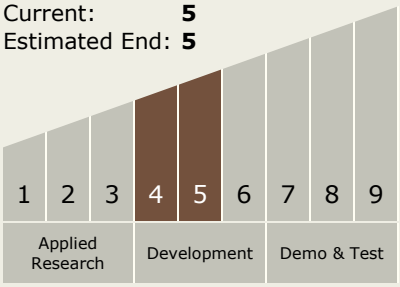
James Szabo

Magnesium Based Rockets for Martian Exploration, Phase II

Completed Technology Project (2011 - 2013)

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.5 Hybrids

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System